Optimizing a Façade from a Daylighting Perspective

The lighting/electrical engineer plays a necessary role in the design of a high-performing façade. The lighting/electrical engineer should be working hand-in-hand with the mechanical engineer as well as the architect during the following processes.

Selecting Essential Facades to Optimize

If you are already at the stage where you are figuring out details of the façade design, you should be at a point where you have some floor plans, sections, and elevations (or hopefully a basic REVIT model!) for the building. If you are not yet at this stage, figuring out façade details may not be the best use of your time right now(perhaps you should help the architect with massing strategies if that is the case). Use your preliminary knowledge of the building to select the key facades to optimize.

- South-facing facades are the most challenging when it comes to daylighting. You must be very aware of how the space and its occupants operate. For South-facing facades, you want to cut out as much direct sunlight penetration as possible through the use of exterior shading devices such as overhangs, lightshelves, vertical fins, etc. For times of the year such as during the winter when the exterior shading cannot block the low angle sun, it is suggested to possibly implement interior shading devices such as roller shades or blinds.

- Select West/East-facing facades could also be worth optimizing for morning and afternoon sun. Also be aware of direct sunlight penetration into these spaces, especially on the West facades where peak cooling loads may occur.

- North-facing facades are excellent for bringing in daylighting to the space without having to deal with direct sunlight penetration

For a more comprehensive and in depth reading on daylighting with windows, see

http://windows.lbl.gov/daylighting/designguide/designguide.html

For the rest of this Wiki, a south-facing façade will be assumed.

Use of Energy Modeling (Also found in From an Energy Use Perspective (Mechanical Engineer)

Energy modeling software like Trane TRACE 700 and Ecotect can be great tools to use during the iterative façade design process.

Optimizing Solar Shading Devices in Ecotect

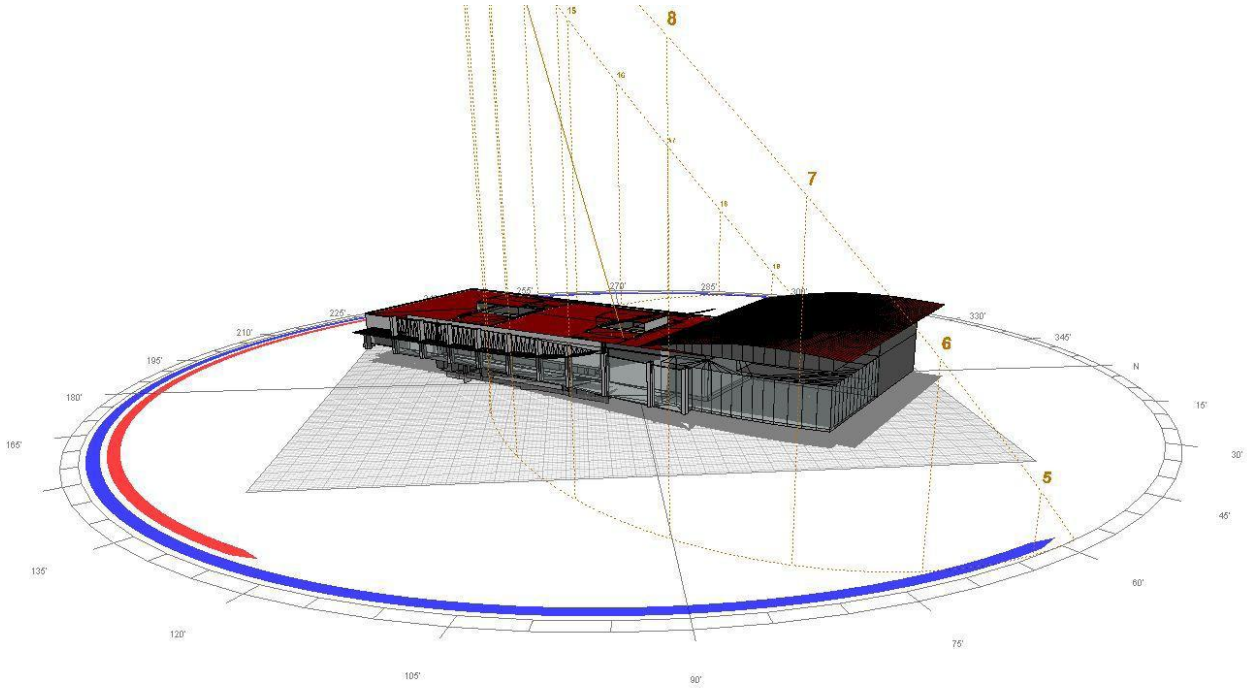
Solar shading devices are analyzed most easily in Ecotect. Ecotect is a great program to use especially if your design team has a decent REVIT model. If only solar shading is to be used in this program, follow these instructions:

- Add your solar shading devices into your revit model. Suggestions could include roof overhangs, louver systems, or shading devices on the mullions of the façade (both vertical and horizontal).

- From Revit, export your model as a gbXML file. If only solar shading devices are to be analyzed, nothing else needs to be done. If you are looking to use other energy modeling functions in Ecotect, a more complex export process needs to be done. See other BIM Wikis for that information.

- In Ecotect, run a solar study. In the outcome of this study, you can analyze the shading devices from both a visual and numerical perspective. Fig. 1 shows an example of a solar study done in Ecotect.

Fig. 1 – Solar study performed in Ecotect.



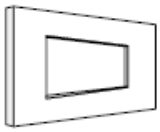
Glazing Material Selection

Two key characteristics to look at when selecting glass is "visible transmittance", which is the percentage of visible light that can pass through, and "visible reflectance", which is the percentage of light that strikes and gets reflected back. Visible reflectance is typically different between the interior and exterior sides of the glass. Other characteristics to look at are solar heat gain coefficient (SHGC) and U-Value. These should be discussed thoroughly with the mechanical engineer to come to the most effective glazing selection for the project.

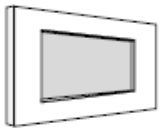
A good way for selecting a visible transmittance to shoot for is to use the "effective aperture approach". This says that the higher the window-to-wall ratio you have, the lower the visible transmittance you want for comfortable daylighting and vice-versa. EA = Window-to-Wall ratio x Visible Transmittance. A good target value for this is 0.20 – 0.30.

Also with a larger window area, you should aim for a lower SHGC to maintain thermal comfort in the space and to avoid energy losses.

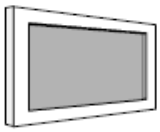
As a final note, if possible vary the glazing selections by each façade for a well daylit building and an overall energy efficient building.



Clear Glass
WWR = 0.30
high VT = 0.88



Tinted Glass
WWR = 0.50
medium VT = 0.53



Heavily Tinted
or Reflective
WWR = 0.70
low VT = 0.38

Effective Aperture (EA) is visible transmittance (VT) x window-to-wall ratio (WWR). These three windows all have the same EA of 0.26.

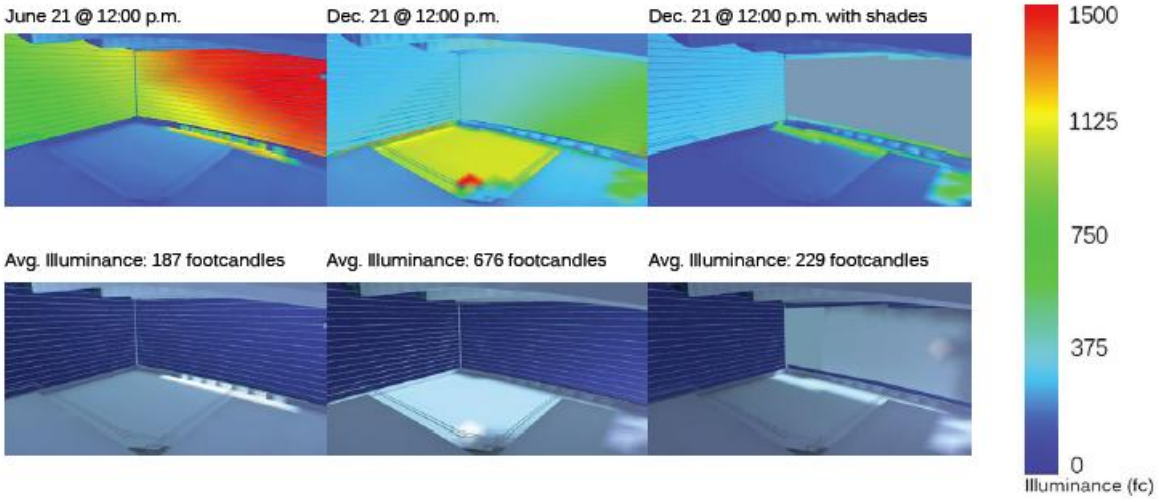
Use of Energy Modeling

Some software that is great for preliminary glazing selection and performance comparisons are AGi32 and COMFEN 4.0

In AGi32, you can import a 3D CAD model of your space and apply your selected glazing material to your façade to see how daylight will enter your space. This again can also show how effective your shading devices are as well as implement interior shade devices and test their performance.

Viracon Low-e Insulating Glass with White Frit Pattern
Color: Arctic Blue
Visible Light Transmittance: 34%
Solar Heat Gain Coefficient: 25%

Mechoshades 5300 Series Shade Cloth
Color: Nickel
Visible Light Transmittance: 8%
Openess Factor: 5%



In COMFEN 4.0, you can build simple rectangular models of a space with glazing and test and compare the energy use of multiple scenarios with different glazing materials.